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ABSTRACT

This manual was developed for Compliance Safety and Health Officers (CSHO) of the Occupational Safety and Health Administration (OSHA) to help them carry out their responsibilities when investigating workplace accidents. The content is presented in four sections. The first overviews the investigative roles of CSHO officers, including preinvestigation, onsite, and courtroom activities. Section 2 on investigative techniques discusses site documentation, interviewing, and accident scene examination. The next section covers causal factors analysis and reporting, while the last one summarizes the manual. (EM)

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Investigating Accidents in the Workplace

A Manual for Compliance
Safety and Health Officers

U.S. Department of Labor
Ray Marshall, Secretary

Occupational Safety and
Health Administration
Eula Bingham, Assistant Secretary
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FOREWORD

The Occupational Safety and Health Administration has the authority to investigate workplace accidents for the purpose of determining (1) if there has been a violation of Federal safety and health standards, (2) whether any such standards require revision, (3) whether any new standards need to be developed, and (4) if corrective action will prevent recurrence in the future. To warrant investigation, accidents should meet one or more of the following criteria:

- One or more fatalities, five or more employees hospitalized, or any combination thereof
- Frequently occurring incidents of like nature
- Accidents or events of national importance that involved extensive property damage and could have caused death or multiple injuries
- Those occurring in industries that are the subject of any special program
- Those involving significant publicity

As a compliance officer, your concern is with conditions of the workplace at the time of your inspection. With properly specified standards, your job becomes a straightforward one of assessing whether or not the jobsite is in compliance. As an investigator, however, your mission is to reconstruct the conditions and events of the workplace at the time of an accident. Unlike compliance inspection, it is not always clear what you should be looking for (as explanations for causes of an accident) or when your job has been completed (through having identified all causes of the accident under investigation).

This fundamental difference between investigation and inspection will require you to use a broader range of techniques for gathering information and to develop new analytical skills for finding the cause of accidents. Recognizing that your role as a CSHO is primarily one of compliance inspection, this manual has been developed to aid you in carrying out your responsibilities as an accident investigator.

This manual is not a policy-setting document or a procedures manual. On issues that relate to formal conduct and procedures, you are referred to the *Field Operations Manual* and to the current relevant official directives and memoranda.

Official forms to be completed during investigation are not included in this manual, since they are subject to change.

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Figure 1. BASIC EQUIPMENT FOR ACCIDENT INVESTIGATIONS

CREDENTIALS	☐	CSHO Identification Card
PAPERS, PUBLICATIONS, DOCUMENTS	☐	OSHA Standards
	☐	OSHA File: OSHA Form 36, previous inspection/investigation
	☐	Area Road Map
SAFETY EQUIPMENT	☐	Hard Hat
	☐	Safety Glasses or Goggles
	☐	Earplugs
	☐	Safety Shoes/Rubber Boots
	☐	Protective Clothing
PHOTOGRAPHY	☐	Camera
	☐	Film—Black and White Color
	☐	Flash and Other Attachments
	☐	Photography Log
	☐	Sealing Devices
	☐	Folding Rule (in fractions of feet)
SKETCHING	☐	Graph Paper
	☐	Ruler, Protractor, Compass
	☐	Pencils
	☐	Carbon Paper
INTERVIEWING	☐	Interview Comment Sheet
SAMPLING	☐	Sample Log
	☐	Chemical/Reflective Detectors (Gases)
	☐	Containers and Caps (Liquids)
	☐	Plastic Bags and Envelopes (Solids)
	☐	Tags/Labels
WRECKAGE EXAMINATION	☐	Parts Retrieval Log
OTHER	☐	Stop Watch
	☐	Magnifying Glass
	☐	Sticks of Chalk
	☐	Compass
	☐	50-Foot Cloth Tape

I. AN OVERVIEW TO YOUR ROLE AS AN INVESTIGATOR

Accident investigation, like crime detection and medical diagnosis, often entails a microscopic search for unknowns. Every factor relating to an incident must be discovered, evaluated, and analyzed, in order to determine the actual sequence of events and causes of the accident. The work must be thorough. Often it is a difficult assignment, but its successful accomplishment will make an important contribution to preventing future accidents. All too often, accidents that are ultimately attributable to the same set of causes have repeatedly occurred because investigators lacked the zeal, ability, or knowledge to obtain and analyze all the facts.

Throughout your investigation, interviews, and report writing, you should remember that everything you do has two goals:

1. Determine the cause of the accident
2. Prevent it from happening again

Certain principles of accident investigation should be followed if maximum results are to be secured:

- The investigator(s) should be equal to the demands of the investigation to be undertaken. You should have basic familiarity with the equipment, operation, or process involved and an understanding of the conditions or situations that are likely to bring about accidents of the type that you are to investigate.
- The investigation work force should be adequate to meet the level of effort required. The size of the investigation team can vary widely, depending upon the nature of the accident, its magnitude, and its technical complexity.
- Getting to the scene of an accident promptly is extremely important. In all cases, after the accident has happened and time passes by, it becomes more difficult to obtain facts accurately. Conditions change quickly in many types of accidents, such as those involving exposions or fire. Prompt investigation improves the likelihood that the accident won't reoccur due to the same faulty procedures or environmental conditions.
- Two of the most important attributes you should develop are comprehensiveness and creativity. Nothing can replace a thorough job of gathering facts through photography, interviewing, accident reconstruction, etc. Analysis of the evidence (both during and after its collection) depends heavily upon your creativity, something which can develop only with experience.
- Accidents are rarely caused by a single factor, but rather by the coincidence of several conditions or events.
- The real purpose of accident investigation is to gather information which can lead to improved safety and health conditions in the work environment. Your work, therefore, is not complete until you have determined whether a violation of Federal safety and health standards could have contributed or did contribute to the accident, whether enforcement of those standards could have prevented the accident, and whether OSHA standards should be revised to cover any hazardous condition contributing to the accident. While it is not your job as a CSHO to make specific recommendations for corrective action, your findings on the cause of the accident are an essential first step toward correcting hazardous situations.

A. Preinvestigation Activity

Once you are assigned to investigate an accident, one of the first things you should do is review any existing file on that employer. Your attention should be focused on three steps: (1) review the *OSHA-36 Form*, if one has been prepared and filed; (2) see what the accident history of the company has been; and (3) review the file for any activity relating to standards, inspection reports, citations, employee complaints, etc. All of this information will help you to determine whether or not you will need special equipment or supporting technical specialists.

Give careful consideration to the equipment to be used in the investigation. Although much of the equipment is standard for most investigations, careful thought should be given to the types of special equipment that might be needed. In *Figure 1*, a checklist is provided for basic equipment. Note that this list has been restricted to the most common equipment.

Regarding safety equipment, you should be prepared to comply with all employer safety and health rules and practices at the site of the accident, by wearing or using required safety clothing or equipment. Bear in mind that an accident can greatly change the characteristics of a work area, creating the need for different or specialized safety equipment.

Although you will report to the accident scene promptly, you may be confronted with a situation where the news media have covered the incident even before you were assigned to the case. Occasionally you may find their photographic or film coverage valuable if the scene has been altered between the occurrence of the accident and your arrival. In general, however, it is better to rely on information and photographs you obtain yourself in collecting evidence and making reports. Rely on information given by the news media only as a last resort.

B. Onsite Activity

1. INVESTIGATIVE FUNCTIONS

Every accident is unique and requires an investigation tailored to the particular situation. There are, of course, certain techniques that should be employed in conducting the data gathering analysis. The actual sequence and amounts of investigative activities vary with each investigation (the one exception being that you must seek out the employer or his representative **immediately** upon arrival and present your credentials). By way of introduction to your role as an investigator, several steps in the field portion of the investigation process are briefly described below.

Opening Conference—There must be an opening conference with the employer or the employer's representative. The conference is very important to the overall success of the investigation, since the cooperation of employer and employees will greatly facilitate obtaining accurate evidence. This initial meeting will set the tone for your relationship with the employer throughout the investigation. If the accident happened recently, you will want to make this session brief, so that you can begin your investigation.

Walkaround—As soon as is reasonable, you should conduct a walkaround, accompanied by employer and employee representatives. In cases where there is no authorized employee representative, you should consult with an appropriate number of employees during the walkaround.

Administrative Details—You may wish, if possible, to arrange for office and storage space. If an office can be made available to you, you will find it a convenient place to make telephone calls, store your records and equipment, interview witnesses, and conduct onsite analyses. An area large enough to store debris and wreckage in cases of fire or explosion will also be useful. The lack of these facilities, however, will not seriously hamper your work. They are desirable but by no means necessary.

In conducting your investigation, you will more than likely need some assistance on technical matters. Employees at the workplace can be valuable in this area, as they are intimately familiar with the accident scene's machinery, building structure, piping, wiring, etc.

Documenting the Scene—An immediate task will be to record the scene of the accident, as it exists after the accident. The area should be restricted to authorized persons (even if only for a very brief time), and you should take your photographs and make sketches from several angles. Later, you should gather other information about normal conditions, such as maps, floor plans, elevations of buildings, descriptions and locations of stationary equipment that has been moved or damaged.

Preserving Evidence—In many instances, conditions change rapidly, and irreversibly, after an accident, due to such things as weather conditions or the need to make the area suitable for working again. If you move quickly, the accident scene may be blocked off from unauthorized persons or the evidence may be moved into a secure storage area if one is available.

Interviewing—In many accident investigations, the bulk of evidence on the sequence of events leading up to the accident is obtained through interviewing. If you arrive at the scene soon after the accident has taken place, you should at least conduct brief interviews with workers and other witnesses to obtain an initial idea of what happened and to record the physical and emotional conditions of those involved with the accident. You should conduct more detailed interviews later.

Closing Conference—When you have completed your onsite work, you must conduct a closing conference with the employer and advise and discuss with that employer any apparent violations discovered during the walkaround and investigation. Since much additional analysis work concerning the accident may be required, you should avoid discussing specific findings of your investigation. You may tell the employer of the analysis and report preparation procedure, and you may make some interim suggestions to assure a safe work environment while the analysis and final reports are being prepared.

2. INSPECTIONS WHILE ON SITE

As a CSHO, you should be prepared to conduct an inspection of the workplace in addition to the accident investigation. The Area Director will make the determination, depending on the circumstances surrounding the accident, resources available, and other priority requirements. The inspection may be conducted before, concurrent with, or after the investigation. If, in the course of the investigation, you determine that a complete inspection of the establishment should be made contrary to the Area Director's directions, then contact the Area Director and explain the situation.

Normally, employees may be represented on the walkaround. This does not prevent you from talking with any employee who desires to discuss a possible violation, if it will not interfere with the conduct of the inspection. Upon receipt of such a communication, you should inspect for the alleged violation and record any findings.

Before leaving to investigate an accident, you should obtain all papers, documents, and other materials needed for inspections.

3. DISCLOSURE OF INFORMATION DURING INVESTIGATION

The Department of Labor's policy regarding the disclosure of documents and information "from the files" is governed by the *Freedom of Information Act*. OSHA's policy is to disclose all documents to which the public is entitled under the Act.

However, during the course of an accident investigation, you must not provide any documents or information concerning the investigation to anyone. If news media representatives or other interested persons request information from you or question your activities, you must state only that an investigation is under way and that you are not permitted to provide any information or documents until the findings have been made. Then, information about the specific case will be released from the OSHA Regional Office. All requests for information should be referred to the Regional Office.

4. YOUR RELATIONSHIP TO OTHER INVESTIGATORS

It is likely that there will be other investigators interested in the accident you are investigating. There may be investigators representing the State, county, or city; insurance agents or others representing the owner, union, equipment manufacturers, or families of the accident victims. Because of your expertise, you may be called upon by these other investigators to advise them on OSHA regulations which may be applicable. You should be able to provide this assistance without committing OSHA to specific actions that may not be in consonance with National Office or Regional Office policy.

Generally, the police, fire department, or emergency rescue squads are the first to arrive at the scene of an accident. They usually conduct a thorough investigation and obtain valuable information which possibly may be helpful to you. Your main concern is to determine if there have been any violations of the OSHA standards, and it may be to your advantage to consult the police and fire departments to obtain accurate and valid information that may help you in making an effective investigation.

C. The Courtroom Perspective

Because all accidents you investigate are serious ones, there is a good chance that the incident will end up in court. If this happens, you may be called to testify as a witness. Therefore, you should always proceed very carefully in gathering your evidence during the investigation. In technical matters for which you do not have the required training or experience, you should request the assistance of a specialist.

All evidence must be well documented, so that there is absolutely no doubt in a court proceeding about the validity of your facts. If exhibits are not adequately labeled, if photographs and sketches do not completely cover the accident scene, or if your interview statements are not properly prepared—if for any of these reasons your evidence and testimony might be doubted, they may not be acceptable to the court.

Thus, in deciding whether to call for assistance or in deciding how to gather certain information, base your decisions on the assumption that what you do and the information you gather will have to be defended in court.

Figure 2. PHOTOGRAPHY LOG

page ___ of ___

DATE & TIME	ROLL NUMBER	FRAME NUMBER	LOCATION	DIRECTION	SUBJECT	DISTANCE TO SUBJECT	COMMENTS

II. INVESTIGATIVE TECHNIQUES

A. Site Documentation

1. PHOTOGRAPHING

Photography can serve as a valuable method of recording conditions that may change during the investigation or shortly thereafter. It can also aid in preparing your report and in analyzing conditions at the site of the accident. Photographs should always be taken; **however, you must take precautions to assure that the use of flash or spark-producing equipment will not create hazards.**

The employer should be notified during the opening conference that photographs will be taken during the investigation. In areas where confidentiality of trade secrets is involved, the procedures described below shall be adhered to.

If the employer objects to the taking of any photographs that you believe are essential to the investigation, you should advise the employer that the regulations *(29 CFR 1903.7 (b)* specifically authorize taking or obtaining photographs related to the purpose of the investigation. Additionaliy, if the employer's objection is based on the fear that trade secrets may be disclosed, you should advise the employer of the protections against such disclosures afforded by the *Act (Section 15)*, the regulations *(29 CFR 1903.9)*, and the *Field Operations Manual (Chapter V, paragraph D.6.b)*. Specifically, the employer should be advised, in such cases, that under *paragraph (c)* of the above-cited regulations, all negatives and prints of photographs taken in an area that contains or might reveal a trade secret shall be labled "confidential—trade secret" and shall not be disclosed.

If the employer still objects to taking photographs, the investigation should proceed without such photographs and you should immediately advise your Area Director. If you and the Area Director jointly determine that photographs are essential to complete the investigation, the Area Director should refer the matter to the appropriate Regional Solicitor with the request that a warrant be obtained.

Photographs of the overall scene, wreckage area, and pertinent hardware should be made prior to any adjustments to the scene of the accident. They are helpful in determining what happened as well as in providing illustrations for reports. In instances where unusual wreckage patterns exist, color photographs are of value. Two examples would be in differentiating between smoke and oil discolorations or among various colored paint smears. Stereoscopic photographs of bodies and detailed parts may be useful in the investigation.

Before taking any pictures, you should determine if the scene has been altered. If items have been moved or changed, note what the alteration is and the person's name referencing the change. Items may have been moved to reach an injured person, to fight a fire, or for other legitimate reasons.

Decide before proceeding what must be done, if anything, to preserve the scene. Then, if photographs are needed, make a list of items that you will want to take, dividing them into two groups:

1. Photographs of the scene before moving anything or adding anything
2. Photographs of the scene and closeups with the scales and highlight markings in place

Each of the two groups should include photographs taken at varying distances: overview, midrange, and closeup. Also, remember to photograph from several angles; quite often the camera will catch and retain what the eye has seen and forgotten. Obtaining photographs from different angles will require extra effort. The "four-cornered" approach (front, back, and two sides) usually will provide all needed angles. Each photograph should be numbered and the position of the camera and its direction of vision should be indicated on a map or sketch. A pocket compass will suffice for direction, and location may be obtained by pacing from some object shown on the map. This procedure is necessary primarily to reduce the measurement distortions of a camera lens. Sometimes it is necessary to identify such items as piping, where subsequent identification from pictures can be incorrect unless the distances just referred to are known.

For closeups, use a rule (such as a folding 6-foot rule) next to the object to be photographed in order to provide an accurate scale for the picture. In some cases, it would be desirable to have the rule folded for both the vertical and horizontal dimensions. In photography, a rule that displays fractions of feet is preferable to one with inches, since it shows up much more clearly in the photographs.

When there is a great deal of photography, it is important to document the pictures. As an aid to recalling the many onsite pictures you will be taking, it is recommended that you use a logging device such as the one presented as *Figure 2*. After the photographs have been developed, the following information should be written on the back of, or attached to, each picture:

- OSHA-1 Report Number, Area Number, Region Number
- Employer's name and address
- Location within plant, facility, or site
- Date (month, day and year)
- Time of day
- Location of photographer or identifying number on a sketch of the area
- Brief description of what photograph is trying to identify
- Your signature and number

The original photographs and negatives shall be kept in the investigation file. If additional copies are desired, consult the Area Director. Photographs obtained from other sources also should have all the above information, as well as the name of the source.

2. SKETCHING OR DRAWING

Quite often it is more advisable to sketch or draw (rather than photograph) parts of the accident scene, especially if material has been destroyed or moved by fire or explosions. The following points will make the job a bit easier and provide the degree of accuracy necessary.

- Always use squared (graph) paper, with the value for a square provided at the bottom of each sketch.
- Orient each area sketch with an arrow pointing north.
- Use a strip of the squared paper for measuring any diagonals on the sketch.
- Important objects should be located by an approximate outline.
- Large objects are labeled inside their outlines, while smaller objects are identified outside the outline with an arrow to the object. (**Caution**: the arrow should just touch the line.)
- If you discover that you have too little space in which to put a label, use letters or some other identifiers at the bottom of the diagram or on an attached page.
- Indicate the distance of movable objects from two fixed locations.
- Note the location of witnesses present at the time of the accident.
- If the sketch is used to orient photographs, the location and direction of each photograph should be identified by a letter or number and that identifier placed on the back of the photograph.
- Sketches should be identified on the back, using the same information as for photographs.

B. Interviewing

1. GUIDELINES FOR CONDUCTING INVESTIGATIVE INTERVIEWS

The fundamental purpose of interviewing is to obtain an accurate and comprehensive account from the person being interviewed of all pertinent facts, interpretations, and opinions that relate to the accident being investigated. To accomplish this objective, the interviewer must conduct the interviews in a professional manner. The person being interviewed must be free to describe the accident and provide other information without being influenced either by the interviewer's personality or the setting in which the interview is taking place.

In many accident investigations, interviews may be your primary source of information. It is important, therefore, that the interviews be accomplished in a thorough and efficient manner. The following guidelines are presented for conducting interviews of the highest quality:

- Have a plan and know where the interview is going to lead. Prepare questions ahead of time, if possible.
- Make sure you understand the technology of the equipment or the process involved in the accident. With this knowledge, you will not only ask better questions (to elicit more precise and relevant information), but you will also gain the respect of the person being interviewed.
- Schedule the interviews so that you avoid a hurried atmosphere. Allow enough time to hear what the person being interviewed has to say. Some people are reluctant to talk until they become better acquainted with where the investigation is headed.
- Hold your interviews in private to avoid distractions. Though a quiet room is best, you may have to conduct the interview at the scene of the accident in order to have technical matters explained. Private interviews also emphasize that your attention is directed entirely at what the person being interviewed has to say.
- Put the person being interviewed at ease. Avoid being overbearing in speech, voice, or mannerism. Be careful not to talk down to the person or use language that is above his or her understanding.
- Avoid asking any questions that suggest an expected answer and avoid questions that can produce only "yes" or "no" answers. Above all, remember that your questions are for the purpose of obtaining information.
- Let the person talk, but not ramble. Rather, interrupt where necessary and turn the conversation back to the subject at hand. Always keep control of the interview.
- For witnesses, divide the interview into two parts: (1) let the person describe what happened with no questions, and then (2) ask your questions and have the two versions written down. This assures that statements given have not been influenced by the interviewer.
- Close the interview in a courteous, but firm, manner. Encourage the person to contact you if any other pertinent information comes to mind.
- Record what was said during the interview and wait until immediately after the interview to record your impressions and judgments. This prevents mixing your own reactions with those of the person being interviewed.

2. DETERMINING WHOM TO INTERVIEW

Obviously, you must know whom to interview in order to start the investigative proceedings, and the best place to start is to ask the employer to develop a list of names (to be provided at the opening conference). Also, ask each person you interview for the names of others who were present.

Much of your investigation will consist of interviewing. Some of the people interviewed may have witnessed the accident. Others may be able to provide only one or two facts, such as work habits of the injured, or the history of past troubles with equipment. Do not predetermine that a person is not worth interviewing, especially if that person has indicated that he or she has something to say.

3. CONDUCTING A COMPREHENSIVE INTERVIEW

The best interview meets the criteria of being complete, correct, and pertinent. Your goal is to hear and record all the information given. It can be most embarrassing to discover later that one of those interviewed had vital information which he or she did not give because you failed to ask the right questions. The best interviewers use a simple formula that should "get it all" for you. That formula is to ask the six key questions: **Who? What? Where? When? How? Why?**

Who was injured? Who installed the equipment? Who was responsible for it? The nature of the accident will determine the exact questions you should ask.

What happened? What did the people do? What equipment or facilities were involved? This line of questioning should lead you into actions, events, and physical objects.

Where was each worker located? Where was the overhead crane? Where was the firefighting equipment? The "where" questions have a way of helping you determine what caused the accident and discover the conditions that brought it about.

When? The answers to the "when" questions should contain more information than a clock reading. Though time is important, relationships are often even more important. "When" questions often elicit information on relationships between pairs of activities or events.

How? This type of question should provide information on the interaction and relationship among the activities and events (going beyond their timing and into the functional relationships among them). "How" questions refer not only to the action of equipment but to action of the injured as well.

Why? Answers to "why" questions should give you some clues as to corrective measures, since the answers will focus on unsafe acts or hazardous conditions.

4. CREDIBILITY OF WITNESSES

The six basic questions provide the opening for the investigation and the foundation upon which it can be developed. There are, however, some points to remember about those being interviewed. They are all human and, as such, are subject to human traits (being mistaken or misleading, withholding information, or exaggerating).

Those concerned with an accident tend to be satisfied that their duties and roles had been properly performed and that no act of theirs had anything to do with causing the accident. However, at the same time, there may be an uneasiness in their minds that perhaps a thorough investigation will implicate them because of some little act of commission or omission on their part. Therefore, they may be quite willing to let the matter drop without getting involved in any real investigation or be somewhat misleading in the interview, in order to protect themselves.

Additionally, there is the problem of how people regard investigators. The objective of most investigations—such as those conducted by insurance claims agents and detectives—is to determine who is at fault. To overcome reluctance (or even open hostility), you must impress upon all those you interview that your objective is to gather data to serve as a basis for preventing future accidents.

Remember, when taking statements from witnesses, do not assume that the information is always valid. No matter how honest they may be, witnesses' accounts of the accident will inevitably be colored by individual personality and perspective. In fact, where you find total agreement among witnesses, the witnesses may have talked over the situation previously. In this case, you should listen to each and record his or her statements. Then, listen to their conversations with each other for points of disagreement.

Since accidents typically occur with little forewarning, witnesses are not prepared for them. Consequently, they observe only a few key points and imagine the rest. With this in mind, do not be surprised if some witnesses realize, during the restaging of an accident, that they could not have seen all of what they reported to you.

We all recall the tale of the six blind men and the elephant. All of them were telling the truth about the elephant. Each, however, emphasized the fact which impressed him about the elephant—each had only a part of the entire picture. Your job in the investigation is to construct a composite "story" using the various accounts of the accident and other evidence.

Some rapport can and should be established between you and the person being interviewed. A good practice is to keep the person's name written down in such a manner that you can refer to it during the interview. Also, if you can gather a little preliminary information about the person to be interviewed, you may determine the reasoning behind his or her answers. The safety supervisor is likely to see an accident in an entirely different way than the floor supervisor. The worker, who may feel that he or she is in some way responsible for the accident, may be quite reluctant to

speak about it. Consider where the interview is being held (at the scene of the accident, in a hospital room, employee's home, or the employees' lodge). If possible, you should interview each person alone.

5. PREPARING STATEMENTS

Try to obtain a statement from each person whom you interview. Statements provide a record for your investigative report and may be used to refresh the thinking of those interviewed, as well as of the investigators. Statements should be signed if possible, but employee signature is not required.

Statements taken during the interviews should be in a form that will be useful. Statements should be clear, brief, but complete. Remember, you will be writing a report from these statements later, and you may have to use them in court. To avoid misunderstandings, the statement should be read to the person who has given it to you.

Though statements should be written at the time of the interview, a tape recorder may be used when circumstances warrant it. If a tape recorder is used, the conversation should be transcribed and the transcription should meet the requirements of the *Field Operations Manual, Chapter V.* The statement should use many of the actual words and phrases of the person who gave it. Since the sequence of events is important, make sure the written statement agrees with what the person had to say. If there are mistakes in the prepared statement, do not erase. Instead, draw a line through the incorrect words and write in the corrected words. For statements that are signed, every change must also be initialed by the person giving the statement.

6. ANALYZING THE TESTIMONY

Before using testimony to reach conclusions, the investigator should determine how much valid, factual evidence it contains and how much of the information is conflicting. For accidents in clear view of all witnesses, this job may be a relatively simple one, since the probability of conflicting testimony in such cases is unlikely.

On the other hand, where the circumstances are complex and where a large number of conflicting statements have been taken, the investigator must carefully review and evaluate the testimony. Only substantiated testimony should be relied upon in the final analysis.

C. Accident Scene Examination

1. SAMPLING

There are many reasons for taking samples of materials during an accident investigation. Samples may reveal the cause of death or injury.

In cases where it is suspected that some mechanical or structural failure contributed to the accident, you may wish to take samples of soil, concrete, or parts of machinery suspected of failure. Samples of materials taken from the scene may reveal, for example, that insufficiently cured concrete contributed to the collapse of a building or that unstable soil conditions led to a trench or excavation cave-in.

In cases where violations of health standards are the suspected cause of fatalities or casualties, you may find it necessary to take air samples or other samples to check for the presence of impurities or toxic substances. These samples may show the presence of harmful gases such as chlorine or carbon monoxide or of dangerous particulate matter such as asbestos dust.

You will find sampling procedures and updated OSHA collection procedures in the *Field Operations Manual* and *Program Directives for Industrial Hygiene Procedures.*

2. LABORATORY ANALYSIS

Laboratory analysis of samples taken during an accident investigation is usually performed. After the samples have been collected and all appropriate paperwork has been completed, samples which are to be chemically analyzed, such as air or dust samples, must be packaged and shipped by certified mail to the OSHA Analytical Laboratory in Salt Lake City. For specific instructions on obtaining laboratory analyses on samples sent to Salt Lake City, consult the *Industrial Hygiene Field Operations Manual.*

As a general rule, structural and mechanical analyses are performed either at a local independent laboratory or at a Government laboratory, depending on area and regional policy. You should, of course, follow the normal procedures in your area for obtaining these analyses.

D. Other Considerations

In addition to the major techniques and approaches to be employed in carrying out an investigation, there are several other, more specialized aspects of investigation with which you should be familiar. Each of these is presented in this final portion of Section II.

1. WEATHER

In some investigations, the weather will be an important factor in determining the possible causes of an accident. It is therefore important that you establish exactly what the conditions were at the time of the accident. For example, an individual could have reported seeing a flash of lightning before being knocked unconscious, yet a check with the weather bureau might confirm that the weather conditions for that day could not have produced lightning. One could conclude that the worker actually had observed an explosion.

Weather conditions can directly affect worker performance or can lead to the use of certain equipment which, in turn, may start the chain of events leading to an accident. For example, flash flooding may cause workers to use a pump before properly checking its safety features.

Clearly, the weather can cause or contribute to accidents. In your investigation, do not omit the weather and its possible role in the accident.

2. FIRE

If an accident involves a fire, it is of the utmost importance that you determine the exact nature of the fire. Was the fire started as a result of the accident? In the case of explosions, did the fire cause the explosion? Did the overloading of an electrical circuit as a result of malfunctioning equipment cause the fire?

Most fire departments have personnel skilled in determining the cause of a fire. However, the evidence may be buried for some time, both literally and figuratively. Before the analysis and final report are completed, you must know exactly how the fire fits into the overall sequence of events. Do not overlook the fact that the fire and the materials used to put it out can subdue or hide evidence.

Additional information on fire may be found in the *National Fire Codes* and *National Fire Protection Handbook* published by the National Fire Protection Association. By all means consult these codes, for they can be of help.

3. FATALITIES

Persons killed in an accident may still prove to be one of the most informative sources of evidence at the scene of the accident. For example, the autopsy report may identify both the cause of death and other unusual conditions or injuries present though not significant in the fatality. Various findings such as heart attack, foreign gases in the bloodstream, or embedded metal fragments, will play a significant role in your analysis of the accident's chain of events, as well as its cause and contributing factors.

In addition to the coroner's report, the location and position of the person(s) may be significant clues in the investigation. For example, they may help to determine the relationship between fire and explosion (as was mentioned above) or whether the person(s) was attempting to avoid a worse disaster.

In the case of each fatality, it is essential that you determine as much as possible about the deceased's job responsibilities, operating procedures, skills, and shortcomings. This information is important in determining the relationship of each individual to the accident. In your investigation, you should always keep in mind that the person could have:

- Caused the accident,
- Been an unaware bystander, or
- Been attempting to prevent the accident or limit its effects.

Though your most important eyewitnesses may have been killed in the accident, information about them and from autopsies may prove valuable.

4. RECORDS

There are several types of records that may provide a considerable amount of evidence. In addition to company records of personnel involved (particularly for those killed), there are often logs kept of sensitive operations or procedures, as well as "signoff sheets" to maintain accountability among personnel, maintenance records for equipment, etc.

An integral part of your investigation should therefore focus on gathering and analyzing all records that may possibly contribute to determining the accident's causes.

III. ANALYSIS AND REPORTING

A. Causal Factors Analysis

Causes can be determined only through proper investigation to ascertain all factors that contributed directly or indirectly to the disaster. The investigation's findings will reflect on the thoroughness and effectiveness with which you collected evidence and properly analyzed it.

Deductive reasoning, which begins after disclosure of the basic facts and continues through the process of analysis, should be the basis for all investigative findings. It may be necessary to resort to a process of elimination to arrive at conclusions as to what happened.

An often overlooked but important byproduct of investigations is the identification of potential causes of other accidents in the future. Such factors may have had little to do with the accident being investigated; however, the investigator should be aware that such factors do exist and often precipitate future accidents of greater magnitude. The investigator's report should include recommendations for corrective action to eliminate the identified potential causes of future accidents.

1. ANALYTICAL TECHNIQUES

The following paragraphs describe some of the approaches that can be used for analyzing the gathered evidence.

As early as possible after collecting the evidence, you should develop a chronology of events leading to the accident. This may be accomplished by using recordings, telemetry data, test procedures, logs, testimony, and other pertinent data obtained or impounded earlier. Such a time-based sequence of events is an invaluable tool for:

- Substantiating evidence,
- Pointing out specific areas where detailed examination is needed, and
- Categorizing causal factors, as will be described below.

The concept of "known precedent" should be kept in mind during analysis. This concept is based on the theory that events will repeat themselves, given enough trials. When applied to investigation, actual precedents (i.e., causes of previous similar accidents) provide a basis for quickly identifying tentative causes of the accident under investigation. Such factors as previous accident reports, hazards analysis, and failure histories may provide precedents to the overall accident, or to some specific aspects of it. The search for known precedents should include not only the history of the operation in question, but also the histories of similar types of operations.

After an investigation of an accident of even modest complexity, you can expect to have accumulated a great deal of information in the form of interview statements, photos and sketches, lab reports, medical reports, etc. In preparing your analysis (and in presenting the evidence in your investigative report), you should develop a framework for organizing your information.

Everything that can be seriously considered as a possible cause should be explored and evaluated. It also would be helpful, therefore, to employ logic models, in order to insure that all facets of the problems are given due consideration. One or more of the hazard analyses may be used in constructing causation models and developing recommendations. Through the use of logic models, causal factors and recommendations for corrective action may be categorized by areas in which deficiencies exist (or are presumed to exist?. A suggested approach to constructing a logic model is to:

- Select the line of reasoning to be followed,
- Pose hypothetical causes and corrective actions, and
- Test these hypothetical causes through examination of evidence.

The investigator will find that the traditional problem-solving technique of posing hypotheses and developing them to the point where they are proved or disproved is an effective means of arriving at mishap causes. Initially, data should be collected to support the hypotheses. The data should be checked for accuracy and thoroughly analyzed in relation to the hypotheses in question. The logical consequences of the data are tested through comparison with actual conditions, thereby validating or invalidating the hypotheses.

2. THREE TYPES OF CAUSES

The causes of an accident are actually a combination of simultaneous and sequential circumstances, all of which must have been present for the accident to happen. Any circumstance that contributes to an accident may be spoken of properly as one of the causes of the accident, making it only one circumstance of a combination. More specifically, a cause of an accident is any behavior, condition, act, or negligence without which the accident would not have happened. Hence, in seeking causes of an accident, remember that an accident may be the result of the interaction among otherwise innocuous conditions and events.

Since you are concerned with all unsafe conditions and practices involved in each accident, you cannot properly talk about "the cause" of an accident. Investigators who come up with a single cause may have conducted an inadequate investigation and analysis.

Although there may be a predominant factor, to regard it as the only factor involved in the accident is not likely to be either scientific or professional. Such thinking contributes very little to understanding how the accident might have been prevented.

Adverse circumstances are other factors that may be present, without necessarily contributing to a given accident. It is not always easy to determine whether an obviously unfavorable circumstance actually contributed to an accident. For example, while intoxication is an important factor in some vehicle accidents, there may be times when the driver's intoxication is not the cause of the accident. A sober driver may drive a vehicle into the rear of one operated by a drunken driver who had quite properly stopped his or her vehicle at a traffic signal. The drunken driver should be arrested for intoxication, but the accident might have occurred even if he or she had been completely sober. Drunkenness did not necessarily cause the accident, and simply finding a traffic violation (driving while intoxicated) might not be considered a complete investigation for causes of the accident.

In order to get away from the idea that most accidents have a single cause, there is need for specific guidance in defining and identifying accident causes. Such guidance will help you to improve your investigation and ensure better analysis, and set the stage for more appropriate recommendations for corrective action. For these purposes, causes can be classified into three easily recognizable levels: direct, indirect, and contributing. Every accident is the result of at least one direct and one indirect cause, and some accidents have many of each. These are briefly described below:

Direct Causes—These are unsafe acts (doing something or failing to do something specified by law or dictated by safe practices) that brought about the accident. "Unsafe," for this purpose, includes acts that are unusual, unexpected, improper, hazardous, or illegal. Examples of direct causes are:

- Operating at a speed that may be too fast or too slow for existing conditions (e.g., too high a cutting rate on a brittle material)
- Mutual interference of adjacent operations
- Motion or relative position that creates a hazardous situation
- Capacity overload (human or machine)
- Inattention, which in turn prevents a successful evasive action under the existing conditions
- Faulty corrective action taken to avoid or to mitigate an impending accident after the damage was perceived

Indirect Causes—This type of cause includes irregular or unusual conditions that explain why the principal element (person or equipment) contributed a direct cause to the accident. Indirect causes are connected to the accident through the direct causes. Examples of indirect causes are:

- Defective conditions, equipment, materials, or structures. These must have been present prior to the accident. (*Those that are coincident with the accident are often classified as direct causes.*)
- Unusual conditions of weather, visibility, controls, or terrain
- Conditions of personnel—by far the most common type of indirect cause—including (1) permanent though correctable conditions, such as poor eyesight, lack of certain kinds of knowledge, or psychological faults, and (2) temporary conditions, such as intoxication, physical exhaustion, or emotional upset

Contributing Causes—Accidents also have contributing causes, all of which are acts of negligence on the part of some person or organization not directly involved in the accident. Some examples are inadequate codes and standards, lack of policy, failure of supervisors to perform their duties, lack of enforcement, faulty design or inadequate maintenance, inadequate training, and lack of safety training.

To avoid accepting the first cause as the only cause—because it usually is the most apparent—the investigator should strive toward the more effective multiple-cause concept where all the factors involved are known and considered. The multiple-cause concept improves investigation techniques and ensures better analysis, and sets the stage for more accurate and comprehensive corrective action.

3. SOURCES OF FAILURE

As you sort out all the evidence in search of the combination of events and circumstances that brought about the accident, it may be useful to consider several possible types of deficiency. In any particular accident, causal factors will be found in one or more of these areas:

- *Human Failure*—This category includes physical, physiological, and psychological limitations. An example is the failure to follow approved checklists or to follow the use of authorized procedures/techniques. The category also covers factors associated with physical limitations such as illness and blackout and psychological problems such as claustrophobia. Human factors may be underlying or well hidden and become apparent only after a careful evaluation. The failure of a person to perform an act may be classified as a human failure, although it may not be possible to determine why he or she failed to perform it.
- *Technical Data Deficiency*—This deficiency results from use of inadequate technical data, operating instructions, omissions, or erroneous data.
- *Organizational Deficiency*—Often underlying other types of deficiencies, an organizational deficiency exists when an element of management clearly caused or contributed to the mishap

because of inadequate planning, supervision, training, or work practices.

- *Material Failure*—This is defined as the physical breakdown or chemical deterioration of any part, structure, or component.
- *Design Deficiency*—Though sometimes difficult to differentiate from material failure, a design deficiency exists if a part or component is so designed that failure can occur under predictable circumstances.
- *Natural Phenomena*—Defined as acts of nature, this deficiency area does not apply when there is evidence of failure to take normal precautions against these contingencies.

In the final step of analysis, it would be useful to reexamine your thinking in terms of types of causes and sources of failure.

B. Reports Preparation

The final step in the accident investigation procedure is the preparation and submission of your final report. Because the forms to be used change from time to time, they are not listed here. Consult the *Field Operations Manual* for the proper forms to be used and for instructions for completing them.

IV. SUMMARY

Throughout your investigation of an accident, there are two goals you should always keep in mind—(1) to find out what happened and why, and (2) to prevent it from happening again! What has been presented in this publication constitutes a handy reference or manual to help you achieve those two goals. You should have it available at all times; it can help you by referring you to those steps that must be performed in order to determine what act, whether mechanical or human, or a combination, caused or contributed to the accident. Your investigation will, hopefully, help to correct the situation and help to prevent further accidents from occurring.

This manual, then, is a summary of the more comprehensive steps and procedures you must follow during your investigation. It provides you with a guideline toward helping you plan, prepare, and execute an investigation of the workplace.

Briefly, it has covered the following points, which could serve as a quick checklist for you during your investigation.

( ) File and history on workplace and related or similar cases

( ) Special equipment to be used

( ) The opening conference

( ) Walkaround of the workplace

( ) Administrative support

( ) Documenting the scene

( ) Preserving the evidence

( ) Interviewing witnesses

( ) The closing conference

( ) Preparing and submitting report

However, for specific instructions or information, you should refer to your *Field Operations Manual, OSHA Program Directives*, and other pertinent information on the subject of accident investigation.

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